Q1.

(a) Where does transcription occur in a eukaryotic cell?

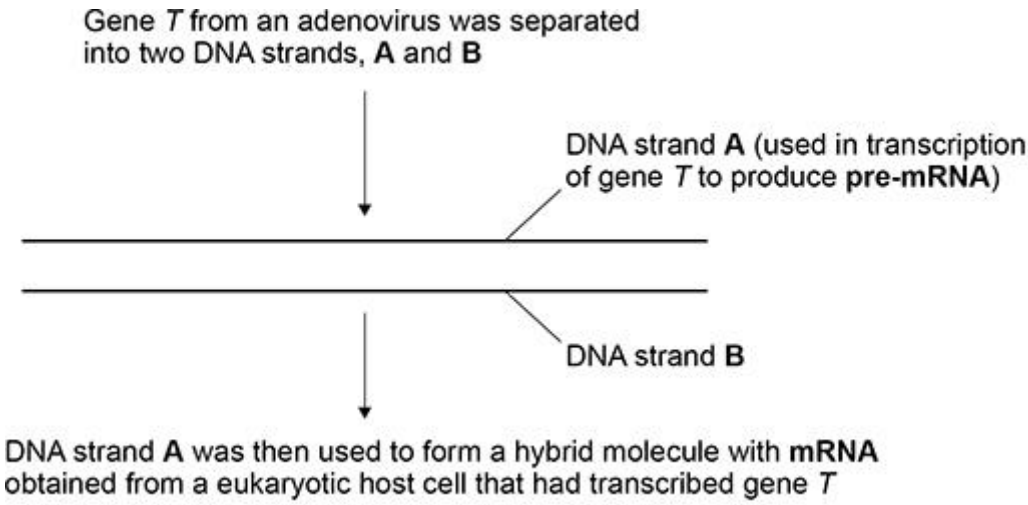
_____

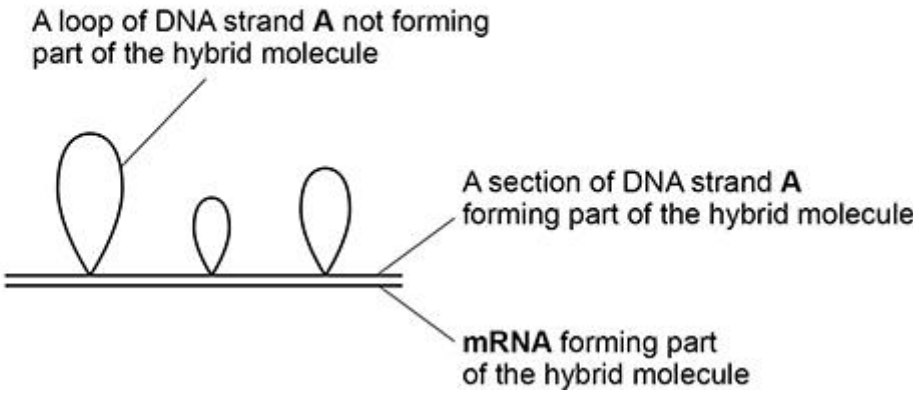
(1)

(b) The genome of an adenovirus is a single, linear molecule of double-stranded DNA. Adenoviruses use eukaryotic host cells to transcribe their genes in protein synthesis. The process of transcription of adenovirus genes is similar to the process of transcription of genes in eukaryotes.

Scientists investigated the process of transcription of this viral DNA.

The figure below shows one of the experiments carried out by these scientists.





Looking at the results of the experiment in the figure above, the scientists concluded that splicing had taken place.

Use figure above to describe and explain why the scientists' conclusion was justified.

(3)

(c) Describe and explain how the results of the experiment in the figure above would differ if the scientists had used prokaryotic DNA.

(2)

(d) Errors in the precise location of splicing in the DNA molecule can lead to mutations.

Explain why.

(1)

(Total 7 marks)

Q2.

(a) Describe the role of haemoglobin (Hb) in the loading, transport and unloading of oxygen.

(5)

(b) Describe how a polypeptide is produced by translation of mRNA.

(5)

(Total 10 marks)

Q3.

(a) Give **three** structural differences between an mRNA molecule and a tRNA molecule.

mRNA	tRNA

(3)

(b) The table below shows mRNA codons and the amino acid coded by each codon.

First base	Second base				Third base
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	U
					C
	Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

Figure 1 shows the mRNA base sequence produced when part of a gene coding for an enzyme is transcribed.

Figure 1

UUU	CGG	GCG

Use the table above to give the amino acids coded by the mRNA base sequence in **Figure 1**.

(1)

(c) A mutation occurred in the part of the gene transcribed in part **(b)**.

Figure 2 shows the mRNA base sequence produced when the identical part in the mutated gene is transcribed.

Figure 2

UUU	**AGG**	**GCG**

The amino acids coded by this mRNA base sequence form part of the enzyme's active site.

Use all the information in this question to:

- name the type of mutation that occurred to produce the mutated gene
- give the change in **DNA** caused by this mutation
- explain the effect this mutation will have on the function of the enzyme.

Type of mutation _____

Change in DNA _____

Explanation of effect on function of enzyme _____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

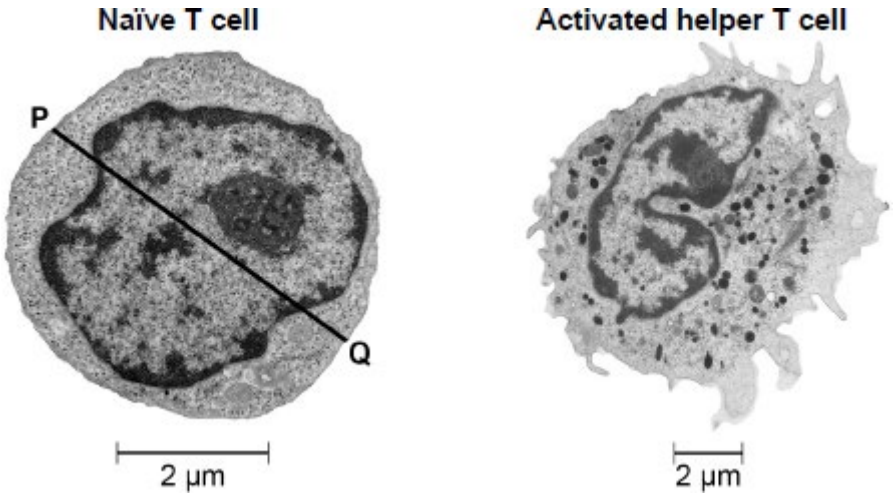
Q4.

Scientists investigated the activation of T lymphocytes.

The scientists studied two types of cell:

- naïve T cells, which are T cells that have not yet been in contact with a foreign antigen
- activated helper T cells, which are T cells that have been activated by a foreign antigen.

The figure below shows electron microscope images of the two types of cell.



The activated helper T cell has a volume of 463 µm^3

(a) Calculate the volume of the naïve T cell shown in the figure.
Then calculate how many times larger the activated helper T cell volume is compared with the naïve T cell volume.
Assume the cell is spherical.
Use line **PQ** to measure the diameter of the naïve T cell.

Volume of a sphere = $\frac{4}{3}\pi r^3$ where π is 3.14

Show your working.

Volume of naïve T cell _____ µm^3

Number of times larger the activated helper T cell volume is compared with the naïve T cell volume _____

(3)

(b) State **one** feature that shows the images in the figure in part (a) were taken with an electron microscope and **not** an optical microscope.

Explain your answer.

(2)

(c) State **one** role of a helper T cell.

(1)

(d) The rate of translation is increased in T cells activated by antigens.

Describe the role of tRNA in translation.

(2)

(Total 8 marks)

Q5.

(a) Which statement about the function of ribosomes is correct?

Tick ✓ **one** box.

Site of transcription, catalyse the joining of amino acids by hydrolysis reactions	☐
Site of transcription, catalyse the joining of nucleotides by condensation reactions	☐
Site of translation, catalyse the joining of amino acids by condensation reactions	☐
Site of translation, catalyse the joining of nucleotides by hydrolysis reactions	☐

(1)

(b) Name **two** biological molecules that can be coded for by a gene.

Do **not** include a polypeptide or protein in your answer.

1 _____

2 _____

(1)

(c) Scientists investigated the structure of the endoplasmic reticulum.

The table below shows some of the scientists' results.

Type of endoplasmic reticulum	**Percentage of endoplasmic reticulum made of phospholipids**
Rough	46.8
Smooth	52.5

Use the data in the table to suggest how the structure of rough endoplasmic reticulum is different from the structure of smooth endoplasmic reticulum **and** how this is related to their functions.

(3)

(Total 5 marks)

Q6.

(a) Give the **two** types of molecule from which a ribosome is made.

1 _____

2 _____

(2)

(b) Complete the table to give **four** structural differences between a DNA molecule and an mRNA molecule.

	DNA structure	**mRNA structure**
1		
2		
3		
4		

(4)

(Total 6 marks)

Q7.

(a) What is a gene?

_____

_____

(1)

(b) Describe how the production of messenger RNA (mRNA) in a eukaryote cell is different from the production of mRNA in a prokaryote cell.

_____

_____

_____

_____

_____

_____

(2)

(c) Scientists produced a short, single-stranded, artificial nucleic acid, called PNA. The PNA binds to a small section of DNA.

The scientists introduced PNA into cells and discovered that these cells produced less mRNA than cells that did not contain PNA.

Suggest how PNA affected the transcription of the section of DNA.

_____

_____

_____

_____

_____

_____

(2)

(d) Describe the role of ATP in the process of translation in protein synthesis.

_____

_____

_____

_____

_____

_____

(2)

(Total 7 marks)